

demiological studies, and mechanistic studies. "Just taking the animal and human studies alone probably wouldn't have been enough to classify it as a known human carcinogen," he said.

Until recently, the IARC used only animal and epidemiological studies to support the classification of a compound. The animal studies provided a baseline of where dioxin is active and at what levels it could cause cancer in animals. Coupled with the epidemiological studies, it was shown that those same levels could cause cancer in humans.

The human studies went even further to show a positive association between dioxin exposure, dioxin body burden, and cancer risk. This correlation has held up in multiple sites of the body. "The human studies are new and relatively consistent and convincing, but there was still some doubt," said Lucier. "[The characterization] was pushed over the edge by the mechanistic information."

Mechanistic studies showed that TCDD functions like a steroid receptor, although it is distinct from it. One particular receptor, which is required for TCDD to exert its damaging effects, exists in humans as well as in experimental animals. By binding with this receptor, TCDD appears to be able to modulate pathways important in the cell and to change gene expression in these pathways. "All lines of evidence are consistent with the idea that the mechanism by which dioxin causes cancer in rodents is operating in people," said Lucier. The IARC will now use mechanistic information to upgrade or downgrade a chemical's classification.

Because of the change of TCDD's classification to a known human carcinogen, the U.S. EPA will be reevaluating their risk assessment of dioxin and the dioxin models on which they base their regulatory policies. Estimates are that the average body burden of dioxin of approximately 5 parts per trillion in the fat of humans will cause 0–40 cancers per million people over the course of their lifetimes. The EPA is forced to take regulatory action to control exposures whenever a known chemical carcinogen is responsible for greater than one cancer per million.

Dioxin is produced as a by-product of chemical processes in most cases. All of the sources of dioxin pollution have not been identified, which makes it even more difficult to regulate. Lucier hopes to promote the idea of policies to reduce the body burden found in humans, identify the major sources of dioxin, and minimize production from these sources. "Dioxin is symbolic of the clash between environment and industry," said Lucier. "In my mind, the significance of this is to help focus the debate on the dose–response issue where the legitimate debate lies."

EHPnet

More Than Just Unleaded

The environmental effects that have accompanied America's obsession with the automobile are well known. Inefficient internal combustion engines are quickly depleting the world's supply of fossil fuels while emitting pollutants that threaten human health and contribute to global warming. At the same time, U.S. oil imports account for a full quarter of the nation's trade deficit, and this dependence on foreign oil has created numerous foreign policy problems.

However, giving up the freedom that comes with driving in favor of public transportation is not an appealing idea to many car owners, and the 8.5 million new passenger cars purchased in the United States last year are evidence that, despite their drawbacks, motor vehicles remain a fixture of the U.S. culture.

According to information available on the Alternative Fuels Data Center (AFDC) World Wide Web site at <http://www.afdc.doe.gov/>, however, the solution to this transportation dilemma may be simply to change the way cars are powered. The AFDC is the branch of the U.S. Department of Energy that has been charged with researching and evaluating new technologies to turn the gas-guzzling vehicles that occupy the highways into efficient, environmentally friendly machines.

The Alternative Transportation Fuels and Vehicles link on the AFDC home page is the gateway to a myriad of information on vehicles that run on fuels such as ethanol, methanol, compressed natural gas (CNG), and liquefied petroleum gas (LPG). In many cases, these fuels can be used in the same engines that burn gasoline with only minor modifications. However, they are inherently cleaner than gasoline because they emit less nitrogen oxides and hydrocarbons and because the hydrocarbons they do emit are less likely to react in the atmosphere to form ozone. From the Alternative Transportation Fuels and Vehicles page, the Demonstration & Evaluation Programs page is the hub for links that describe research being conducted on various vehicles including passenger cars, cargo trucks, city buses, and Federal Express delivery vans. For example, fuel economy data are presented for the fleet of the Clean Air Cab Company (under the Light-Duty Vehicle Program link). This Washington, DC-based company is the first taxi service in the United States to operate all of its vehicles on CNG. Reports on the pollution levels associated with each alternative fuel are available under the Emissions Program link on the Demonstration & Evaluation Programs page. Other resources linked to the AFDC home page include maps to alternative fuel refueling sites around the United States, lists of alternative fuel vehicles that are being manufactured for the coming model year, and back issues of two alternative fuel newsletters.

Electricity is the alternative fuel that has the greatest potential for reducing air pollution as battery-powered motors produce no emissions. However, electric cars must be charged frequently and the batteries often have short life spans. These technological limitations combined with the lack of recharging stations in the United States can make owning an electric car a frustrating experience. Until better batteries and a better infrastructure are developed, hybrid electric vehicles (HEVs) may be a more practical technology for reducing air pollution. HEVs combine an electric motor with an engine that burns ethanol, methanol, CNG, or LPG. The combustion engine either assists the electric motor in powering the drive wheels (parallel configuration) or produces electricity to recharge a storage device (series configuration).

Further information about HEVs can be found by following the U.S. DOE Hybrid Electric Vehicle Program link on the AFDC home page. From here, one link takes users to information on the manufacture and sales of HEVs throughout the world, including a look at HEVs included in recent auto shows. Another link allows users to input certain vehicle specifications and run a simulation that calculates the vehicle's performance.

Information about legislation affecting the use of alternative fuels is available under the Alternative Fuel Information link. The two links under the Incentives and Laws section of this page will bring users to a "clickable" map that accesses a list of all the fuel taxes and incentive programs that have been implemented in each state, while a link at the bottom of the page takes users to a glossary of alternative fuel terms. The Biofuels Information Center link on the AFDC page is the door to information on fuels such as alcohols and ethers that can be produced from cellulose-rich biomass such as agricultural products, aquatic plants, and even municipal wastes. For industry or local government leaders who would like to promote the use of cleaner fuels in their areas, the AFDC page provides a link to the U.S. DOE's Clean Cities program. And, if users are unable to locate the information they need on the AFDC site, the home page includes links to a search engine, a site index, and the telephone number of the Alternative Fuels Hotline.



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